Two-fluid simulations of waves and reconnection with Mancha code

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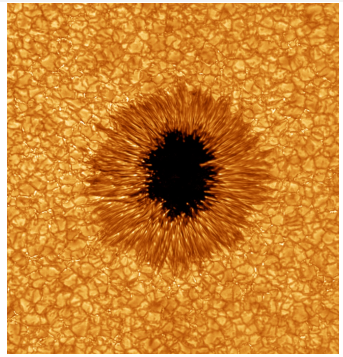
Sun atmosphere layers

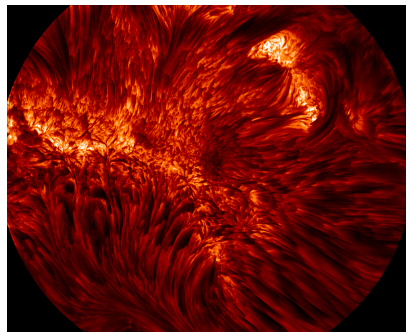
Photosphere

- collisions dominated: LTE, MHD
- relatively easy observations
- diagnostics techniques well developed



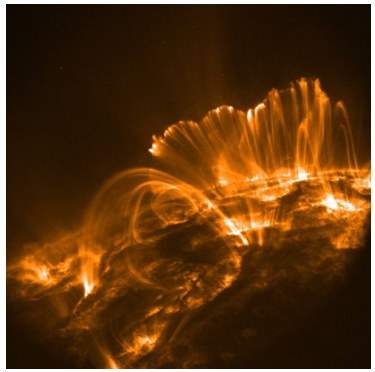
Chromosphere

- not fully collisionally coupled: NLTE, No MHD (frequently not taken into account)
- very few spectral lines
- complicated radiative diagostics



Corona

- magnetically dominated
- very low density
- all ionized, MHD can be applied



2 fluids model

- 13 partial differential equations: 10 variables p , ρ and v of the 2 fluids: charges(_c) and neutrals(_n) + magnetic field
- hydrostatic equilibrium(_0 for p, ρ, B)
  - charges:

$$\rho_{c0}\vec{g} - \vec{\nabla}p_{c0} + \frac{1}{\mu_0}(\nabla \times \vec{B_0}) \times \vec{B_0} = 0 \tag{1}$$

  - neutrals:

$$\rho_{n0}\vec{g} - \vec{\nabla}p_{n0} = 0 \tag{2}$$

- perturbation(_1)
- total variables $x = x_0 + x_1$ for x = $p_c, p_n, rho_c, rho_n, B$, $v_c = v_{c1}$